

## **6. Ex-ante Evaluation**

### **6.1 Relevance**

The Project is highly appropriate for the following reasons:

- The scope of the Project accords fully with Cambodian government's socio-economic development policies prioritizing "Income Enhancement" and "Health Promotion". Freshwater fish is easily available and it is one of highly demanded animal protein sources in Cambodia. The second five-year fisheries sector development plan 2001-2005 expects the increase in aquaculture production by 200% and distinguishes freshwater aquaculture as an important tool to alleviate the protein deficiency and poverty.
- It also accords with the cooperation policy of the Japanese government for Cambodia and the country-specific project implementation plan of JICA, both of which prioritizing "agriculture and rural development."
- Being far from the Mekong River and the Great Lake, supply of freshwater fish is limited in the rural areas of target four provinces in the Project. The agricultural productivity is also low due to natural disasters such as floods and drought, hence the people's interest is high in fish culture as a means to create protein and cash income. Therefore, the Cambodian government is highly expecting cooperation in the field of aquaculture extension.
- Although agriculture (rice cultivation) is the main industry in the target areas of the Project, development of freshwater aquaculture will be effective for diversification of rural livelihood because it can be implemented with low input and small-scale, and in parallel with agriculture utilizing water resources in the wet (high water level) season.
- The Project applies feasible approaches to train seed producing farmers as not only for seed supplier but also for technology/information disseminator towards exiting fish farmers. This approach is based on the results of the AIT project conducted in the past though the project scale and areas were limited.

### **6.2 Effectiveness**

The Project shows high effectiveness for the following reasons:

- The Project takes gradual plans of operation to formulate a farmer-based extension system regarding low cost/sustainable freshwater aquaculture models in rural areas of Cambodia where the government's subsidies are not much expected. Although the income of villagers may not be increased drastically, it can be expected to realize continuous extension of aquaculture technologies and thereby increment of protein food and livelihood; hence the Project Purpose and Overall Goal will be attainable.
- Target aquaculture species are existing ones meaning that the risks for unpredictable disease will be lower comparing to new species because their basic information has already been accumulated.
- The Project achievements will be indicated clearly and objectively, because major indicators of the Project Purpose and Output, such as the number of small-scale farmers and freshwater

aquaculture production, are monitored by the Project. This makes possible to take flexible measures in modification of plans.

### **6.3 Efficiency**

Efficient implementation of the Project will be expected for the following reasons:

- Japan has carried out numbers of technical cooperation projects about sustainable freshwater aquaculture and trained relevant personnel in the neighboring Southeast Asian countries. Those resource personnel and organizations can be utilized as local experts and training places, respectively. The Project will thus be implemented efficiently.
- The nominated implementing body of the Project in Japan side is an experienced private company that has sufficient experience in JICA's programs such as expert dispatch and technical studies in the field of freshwater aquaculture in neighboring ASEAN countries as well as in Cambodia. Therefore, it is possible to utilize efficiently its institutional knowledge and human network acquired in the past experiences.
- The intensity of Japanese input will be higher in the first half of the Project period, thereafter it will be replaced gradually with locally established resources depending upon the outcomes of the Project. The input will thus be managed effectively.

### **6.4 Impact**

The following impact will be expected from the implementation of the Project.

- The Project aims at establishment of a farmer-based extension system. Therefore, the Overall Goal of the Project is achievable because the farmer-based extension system is expected to work continuously in rural societies after the completion of the Project resulting in improvement of protein food supply and livelihood.
- The Project encourages rural small-scale aquaculture and contributes to narrow the gap on local supply of freshwater fishes, whereas freshwater fishery and aquaculture production is presently more or less limited to the basin of the Mekong River and the neighboring areas of the Great Lake.

### **6.5 Sustainability**

The project sustainability will be expected as follows:

- Unlike the conventional method of extension in which government takes initiatives, the Project places emphasis on establishing the farmer-to-farmer extension system in which aquaculture technologies are extended through seed producing farmers and distribute them to other farmers together with technical information. Once the system is established well, aquaculture extension will be promoted largely without extraordinary assistance of the government and sustained by farmers themselves who participate in the extension network even after the completion of the Project.
- Because the methods to establish the aquaculture extension network are to be transferred to extension staff, similar methods are expected to be applied for aquaculture projects in other

areas after the completion of the Project.

- The Project will envisage high level of technical sustainability through application of not only Japanese original technology but also modified technologies and experiences that had been developed in the neighboring Southeast Asian countries with Japanese technical cooperation in order to meet the local conditions and needs.

## **7. Monitoring and Evaluation**

### **1) Monitoring**

The progress of individual project activities is monitored basically through the course of the project activities. The practical monitoring formation of the Project will be clarified through the discussion on individual detailed activities, which will be made after the commencement of the Project.

### **2) Evaluation**

The annual achievements of the Project are to be reported to the JCC and evaluated jointly by Cambodia and Japan sides, and then feed backed to the plan of the next year. In particular, the JICA headquarters will send evaluation missions at the mid-term of the Project and about half year before completion of the Project, so that milestone evaluation will be done in order to improve the project activities.

## Annex 1: Project Design Matrix (PDM)

**Project Name:** Freshwater Aquaculture Improvement and Extension Project in Cambodia

**Target Area:** Four Provinces (Prey Veng, Takeo, Kompong Speu, Kampot)

**Project Period:** 5 years from the arrival date of the first JICA expert(s) that is planned in February 2005

**Target group:** Small-scale farmers, extension staff at provincial level, poorest farmers without land

**Date:** December 2004

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<p><b>Overall goals</b> Aquaculture production in target areas is increased.</p>	<ul style="list-style-type: none"> <li>• Aquaculture production of target villages is increased by ( ) times.</li> </ul>	<ul style="list-style-type: none"> <li>• Post project monitoring report</li> </ul>	
<p><b>Project Purpose</b> Small-scale aquaculture technologies are extended largely in target areas.</p>	<ul style="list-style-type: none"> <li>• Number of small-scale fish farmers is increased from existing 2000 households to 4400 households.</li> </ul>	<ul style="list-style-type: none"> <li>• Project monitoring reports</li> </ul>	<ul style="list-style-type: none"> <li>• Price of cultured fishes is not largely declined</li> </ul>
<p><b>Outputs</b></p> <ol style="list-style-type: none"> <li>1. Seed producing farmers are trained among existing small-scale fish farmers by improving their aquaculture technologies.</li> <li>2. Small-scale aquaculture technologies and its extension methods are improved.</li> </ol>	<ul style="list-style-type: none"> <li>• 20 seed producing farmers are developed and produce seeds by themselves</li> <li>• Small-scale aquaculture technologies suitable for local conditions are developed and its extension manual is prepared</li> </ul>	<ul style="list-style-type: none"> <li>• Project monitoring reports</li> <li>• Technical reports/manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Outbreak of serious fish disease does not occur.</li> <li>• Natural disasters such as extraordinary drought and flood do not take place.</li> </ul>
<ol style="list-style-type: none"> <li>3. Aquaculture-related activities to benefit the poorest landless farmers are promoted.</li> <li>4. An aquaculture extension network in rural area is developed</li> </ol>	<ul style="list-style-type: none"> <li>• Stock enhancement activities are undertaken in 20 community ponds</li> <li>• 2,400 small-scale farmers carry out aquaculture by themselves.</li> <li>• ( ) farmer's groups carry out group activities.</li> </ul>	<ul style="list-style-type: none"> <li>• Project monitoring reports</li> <li>• Project monitoring reports</li> </ul>	

Activities	Input [Japanese side] (Total: about JPY 550,000,000)	[Cambodia side]
1.1 Review the result of foregoing projects of similar type, analyze current situation and identify problems in rural aquaculture of target provinces	a) Experts: (Long-term 3 persons) Chief Advisor/Extension Administration, Aquaculture Technology Improvement and Extension, Rural Development/Coordinator	a) Counterparts (Local society) New seed production farmers, community pond management organization (person) (Government) Necessary number of counterparts and administrative staff are assigned from the Department of Fisheries, Provincial Fishery Offices and the Bati Seed Production and Research Center
1.2 Select model villages to train seed producing farmers based on the baseline survey result.	(Short-term) Broodstock Management/Seed Production, Participatory Planning, Feed Development, Community Pond Management, Gender Mainstreaming, Marketing of Cultured Fishes, Facility Design, Tendering Support/Supervision of Construction, etc.	b) Facilities and equipment Basic facilities and equipment necessary for the Project including offices, meeting rooms, training rooms, laboratories and fish ponds
1.3 Select candidate seed producing farmers in the course of extension activities on the nursing and grow-out technologies extended towards small-scale fish farmers of model villages in cooperation with local extension staff	b) Equipment provision Vehicles and various aquaculture equipment, as per necessity	
1.4 Train seed producing farmers in cooperation with local extension staff through extension activities and intensive training for the candidate farmers on the broodstock management, pond management, nursery operation, marketing, etc.	c) Acceptance of trainees Two to three trainees will be accepted in Japan or the third countries per year.	
2.1 Train local extension staff on the aquaculture technologies and extension methods.	d) Operation cost	
2.2 Strengthen small-scale experimental facilities to support technical improvement.		
2.3 Compare and examine small-scale aquaculture technologies suitable for local conditions in the small-scale experimental facilities.		
3.1 Undertake stock enhancement activities through release of breeders and seeds in the community ponds.		
3.2 Arrange management scheme for the community ponds		
4.1 Prepare a farmer-based aquaculture extension program in cooperation with the seed producing farmers and the local extension staff.		
4.2 Train small-scale fish farmers through training and extension activities conducted principally by seed producing farmers, utilizing improved technologies by the Project.		
4.3 Encourage grouping of small-scale fish farmers through distribution of seeds, aquaculture-related equipment and technical information in the rural area.		
4.4 Incorporate aquaculture into school activities		
4.5 Prepare farmer-based aquaculture extension programs for the target provinces by summarize case studies of small-scale aquaculture activities.		

Note: The indicators related to aquaculture production and the number of farmers' group will be set based on the baseline survey.

Annex2 Plan of Operation (PO)

Outputs and Activities	Schedule of implementation					Responsible organization in charge		Collaborative organizations
	1st Year	2nd Year	3rd Year	4th Year	5th Year	Central level	Local level	
<b>Output 1. Seed producing farmers are trained among existing small-scale fish farmers by improving their aquaculture technologies.</b>								
1.1 Review the result of forgoing projects of similar type, analyze current situation and identify problems in rural aquaculture of target provinces	■					AO		Other Offices in DOF
1.2 Select model villages to train seed producing farmers based on the baseline survey result.	■					AO	PFOs	
1.3 Select candidate seed producing farmers in the course of extension activities on the nursing and grow-out technologies extended towards small-scale fish farmers of model villages in cooperation with local extension staff	■	■	■	■	■	AO	PFOs	
1.4 Train seed producing farmers in cooperation with local extension staff through extension activities and intensive training for the candidate farmers on the broodstock management, pond management, nursery operation, marketing, etc.	■	■	■	■	■	AO and BSPRC	PFOs and seed producing farmers	
<b>Output 2. Small-scale aquaculture technologies and its extension methods are improved.</b>								
2.1 Train local extension staff on the aquaculture technologies and extension methods.	■	■	■	■	■	AO and BSPRC	PFOs	
2.2 Strengthen small-scale experimental facilities to support technical improvement.	■	■	■	■	■	AO and BSPRC	PFOs and seed producing farmers	
2.3 Compare and examine small-scale aquaculture technologies suitable for local conditions in the small-scale experimental facilities.	■	■	■	■	■	AO and BSPRC	PFOs and seed producing farmers	
<b>Output 3. Aquaculture-related activities to benefit the poorest landless farmers are promoted.</b>								
3.1 Undertake stock enhancement activities through release of breeders and seeds in the community ponds.	■	■	■	■	■	AO and BSPRC	PFOs and village organizations	
3.2 Arrange management scheme for the community ponds	■	■	■	■	■	AO	PFOs and village organizations	
<b>Output 4. An aquaculture extension network in rural area is developed</b>								
4.1 Prepare a farmer-based aquaculture extension program in cooperation with the seed producing farmers and the local extension staff	■	■	■	■	■	AO	PFOs and seed producing farmers	
4.2 Foster small-scale fish farmers through training and extension activities conducted principally by seed producing farmers, utilizing improved technologies by the Project.	■	■	■	■	■	AO and BSPRC	PFOs and seed producing farmers	
4.3 Encourage grouping of small-scale fish farmers through distribution of seeds, aquaculture-related material and technical information in the rural area.	■	■	■	■	■	AO and BSPRC	PFOs and seed producing farmers	
4.4 Incorporate aquaculture into school activities	■	■	■	■	■	AO	PFOs and schools	
4.5 Prepare farmer-based aquaculture extension programs for the target provinces by summarize case studies of small-scale aquaculture activities.	■	■	■	■	■	AO	PFOs and seed producing farmers	

Remarks: AO: Aquaculture Office of DOF, DOF: Department of Fisheries, PFO: Provincial Fisheries Office, BSPRC: Bat Seed Production and Research Center

### **Annex 3 The Joint Coordinating Committee**

#### **1. Function**

The Joint Coordinating Committee will meet when necessity arises and at least once a year in order to fulfill the following functions:

- (1) To formulate the annual work plan of the Project based on the Plan of Operations within the framework of the Record of Discussions
- (2) To review the results of the annual work plan and the progress of the technical cooperation
- (3) To review and exchange opinions on major issues that arise during the implementation of the Project

#### **2. Chairperson and Members**

- (1) The Secretary of State, Ministry of Agriculture, Forestry and Fisheries will be the Chairperson of the Joint Coordinating Committee
- (2) Cambodian side:
  - a. The Director General of Ministry of Agriculture, Forestry and Fisheries
  - b. The Director General of Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries as Project Director
  - c. The Chief of Aquaculture Office of Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries as Project Manager
  - d. The Director of Provincial Department of Agriculture, Forestry and Fisheries of target province, Ministry of Agriculture, Forestry and Fisheries
  - e. Counterpart personnel of the Project
  - f. Representative of Council for Development of Cambodia (CDC)
  - g. Personnel concerned with the Project to be dispatched by Chairperson, if necessary
- (3) Japanese side:
  - a. Chief Advisor
  - b. Coordinator
  - c. Experts
  - d. Resident Representative, JICA Cambodia Office
  - e. Personnel concerned with the Project to be dispatched by JICA, if necessary

Note: Official(s) of the Embassy of Japan may attend the committee sessions as observer(s).



## **Annex 4: Terms of Reference for Japanese Long-term Experts**

### **1. Chief Advisor/Extension Administration**

- 1) Educational qualification: University graduate or more
- 2) Work experience: More than 15 years of experience in the field of extension administration not only on aquaculture but also on agriculture.
- 3) Required capability of language: Excellent in English and Japanese
- 4) Major Activities:

The Chief Advisor works for overall project management and supervision in cooperation with the Project Manager and Co-Project Manager of Cambodian side and reports directly to the Project Director and the JICA Cambodia Office. The Chief advisor's such assistance includes, but not limited to, the followings;

- a. To prepare and update the detailed plans for the PO in cooperation with Cambodian counterparts and other JICA experts
- b. To organize and facilitate relevant organizations for the project activities
- c. To review and analysis foregoing projects
- d. To analyze the results of baseline study which will be carried out by contracted local consultants, and select model villages
- e. To select candidate seed producing farmers to be trained.
- f. To organize and conduct regional/national training courses for the project counterparts and seed producing farmers
- g. To design framework for numbers of training programs in cooperation with other experts
- h. To monitor and supervise the facility improvement program
- i. To monitor and supervise the stock enhancement program
- j. To disseminate technical information through mass-media and other measures
- k. To formulate a farmer-to-farmer extension program in cooperation with seed producing farmers and local extension staff
- l. To encourage grouping of small-scale fish farmers.
- m. To support preparation of provincial aquaculture extension programs.
- n. To supervise JICA long-term and short-term experts and coordinate their tasks
- o. To monitor project progress and prepare progress reports and the final report to JCC and responsible authorities

### **2. Expert on Aquaculture Technology Improvement and Extension**

- 1) Educational qualification: Master degree holder in the field of fisheries or equivalent (hopefully Ph.D. holder)
- 2) Work experience: More than 10 years of experience in the field of aquaculture technologies
- 3) Required capability of language: Good in English and Japanese
- 4) Major Activities:

The Expert on Aquaculture Technology Improvement and Extension is responsible for overall technical matters about freshwater aquaculture in the Project. He/she will work in close cooperation with the Chief Advisor. The major activities include the followings:

- a. To prepare and update the detailed plans for the PO in cooperation with Cambodian counterparts and other JICA experts
- b. To plan, mobilize and coordinate all the project activities from technical aspects.
- c. To review and analyze technical references concerning freshwater aquaculture in Indochina region.
- d. To design curriculum for aquaculture training in different levels of extension system
- e. To prepare for technical training and extension materials in cooperation with Cambodian counterparts and other JICA experts
- f. To design and implement on-farm aquaculture experiments in cooperation with seed producing farmers and extension staff.
- g. To give continuously technical advise to seed producing farmers and ordinary farmers
- h. To coordinate the activities of short-term experts regarding particularly on aquaculture

technologies, i.e., Broodstock Management/Seed Production, Community Pond Management and Feed Development.

- i. To prepare technical papers/manuals regarding aquaculture technologies developed in the Project
- j. To assist the Chief Advisor from technical point of view.

### **3. Rural Development/Project Coordinator**

- 1) Educational qualification: University graduate or more
- 2) Work experience: More than 10 years of experience in the similar project activities
- 3) Required capability of language: Excellent in English and Japanese
- 4) Major Activities:

He/she is responsible for two expertises, namely rural development and project coordination. At the initial stage of the Project, his/her major job will be project coordination, and then gradually participate in the project activities from the rural development aspects. The major activities include the followings:

- a. To prepare and update the detailed plans for the PO in cooperation with Cambodian counterparts and other JICA experts
- b. To coordinate all the project activities in cooperation with the Chief Advisor, i.e., coordination with relevant organizations, administrative work of the project including budgeting, procurement of equipment, arrangement of seminars and workshops, recruitment of local resources, etc.
- c. To assist selection and organization of farmers group in the target areas from the socio-economic point of view
- d. To assist dissemination of technical information through mass-media and other measures
- e. To collect and compile basic information on agriculture and aquaculture activities in the target provinces
- f. To compile all the documents prepared in the Project for submission to relevant organizations
- g. To assist project monitoring and preparation of progress reports and the final report to JCC and responsible authorities

## Annex 5. Preliminary technical examinations of the objectively verifiable indicator of the Project Purpose

The objectively verifiable indicator of the Project Purpose is indicated as “Number of small-scale fish farmers is increased from existing 2000 households to 4400 households” meaning that 2400 households have been benefited by the Project in terms of technical skills enhancement and information dissemination through the farmer-based extension system at the completion of the Project, or in the 5 year project periods. This targeted number is examined preliminary based on the number of seed producing farmers.

### 1) Number of seed producing farmers

Fish seeds are the essential input to start aquaculture. Hence, donors had supported a number of constructions of provincial public hatcheries by their projects in the mid 1990's. However, most of those hatcheries have not been maintained well and there are lots of examples of the malfunctions because of the insufficiency of budget allocated by the government. Since late 1990's, projects which addressed to securing sustainability through training progressive fish farmers as seed producing farmers have been becoming mainstreaming. Although all the projects have not always been successful, seed producing farmers and small-scale fish farmers who start aquaculture by getting seeds from them have been increasing in number gradually.

The AARM project of the AIT, one of the successful project examples, is known to focus on training for candidate seed producing farmers. It had started in 1994, and the on-farm extension activities started in the target areas in cooperation with the PFO's extension staff in 1997. As a result, 14 seed producers have operated their hatcheries by 2003, although it does not seem to be achieved solely by the AARM project (Table A4-1). It counts as an increase rate of approximately 2.3 seed producers per year during the 6-year project period from 1997 to 2003 (Table A4-1)

Table A4-1 Number of seed producers, seed nursers and small-scale fish farmers monitored by AIT/AARM project, and their production in 2003.

Unit: households, tons

Provinces	Seed producers	Seed nursers	Fish farmers	Aquaculture production (ton)
Takeo	7	8	1130	80
Kompong Speu	3	11	426	26
Svay Rieng	4	11	3528	144
Total	14	30	5084	250

Source: Annual monitoring report in 2003, AIT/AARM.

It is expected the JICA Project can improve an efficiency of the trainings for candidate seed producers because it can proceed utilizing the results of other forgoing projects.

On the other hand, there is an anxiety that the extension efficiency goes down, considering that the candidate seed producers of the JICA Project may include a little disadvantageous farmers comparing to the candidate seed producers in the AARM project, which was able to address to active farmers having an easy access to main road and/or some initial funds for business.

Taking into account for the above and the scale of input of the Project, the targeting number of seed producers to be established by the Project is set at 20 in total for the 4 target provinces in 5-year project period. This target is corresponding to a high increasing rate of 4.0 seed producers per year.

According to the answers from the DOF, as of April in 2004, the total number of seed producing farmers is 21 in target areas (9 in Takeo, 6 in Prey Veng, 5 in Kampon Speu, and 1 in Kompot, respectively). Taking this number, the Project is aiming at increase in number of seed producers by about 2 times in 5 years.

### 2) Number of small-scale fish farmers

The number of small-scale fish farmers per seed producer calculated from Table A4-1 is 161 for Takeo and 142 for Kampon Speu. Those numbers are almost corresponding to the results obtained from interview survey to seed producers during the preparatory studies.

Considering that there is a possibility of duplication in counting of small-scale farmers as buyers of fish seeds, one seed producer is assumed to cover the seed demand from 120 small-scale fish farmers. Thus, the targeting number of the small-scale farmers will be 2,400 (20 seed producers×120). This means 120 fish farmers will become new beneficiaries in a year in each 4 province.

## **Annex 6: Result of the socio-economic survey on small-scale fish culture in the target 4 provinces**

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### **1. Survey objectives**

The main objectives of this survey in the target areas are as follows:

- to understand current trends in wild fish catches;
- to understand the status of existed fish farming;
- and to understand the opportunity and needs of non-fish farmers and fish farmers to the development of fish culture in the future.

### **2. Expected outcomes of the survey**

Through this survey it is expected to understand:

- the wild fish caught by farmers surveyed;
- the problems faced by fish farmers;
- and the most immediately need of farmers to start doing fish culture in the future.

### **3. Study methods and data analyzing**

A socio-economic survey was carried out from the third week of April to Mid of May, 2004 in three provinces namely Takeo, Kompot, Kompong Speu and Prey Veng. Two districts in each province (Angkor Bory and Somrong district in Takeo; Dang Tong and Chhouk district in Kompot; Borset and Kong Pisey district in Kompong Speu; Baphnom and Prey Veng district in Prey Veng province) and 3 to 5 communes in each district were selected for the study. The criteria for selecting these communes included accessibility, security and there are many poor farmers. All the villagers who were interviewed were randomly selected. Totally 241 farmers were interviewed, in which 59 farmers in Takeo, 60 farmers in Kompot, 60 farmers in Prey Veng and 62 farmers in Kompong Speu province.

The survey was conducted to understand the socio-economic of the farmers involved and non-involved in fish culture operation. The survey also aimed to obtain information related to income generation, rice-field fisheries and cultured fish production. Therefore, two different groups of farmers were independently interviewed: fish growers (so called trial fish farmers) and non-fish growers (non-trial fish farmers). About 57% of the interviewees were fish growers and the rest of them were non-fish growers (43%). The data collected were input into EXCEL Software for analyzing and plotting graphics.

## **4. Results**

The data was verified three times before analyzing, after that it was analyzed and plotted into graphics.

### **4.1. Population size and family structure:**

The member of the families in these four provinces was found to be in the range of 2 to 13 members. More than 49% of the families had 6-8 members in the family, while 40% of the families had 3-5 members. The overall average size of the families was found to be 6.06 persons/family (Table 1). On an overall average, each family had 4 children. In most cases, families had two male and two female children. Those families which had four children did not desire to have more, while those with less than four children

opted for additional children. The average size of the family at the surveyed places in Kompot province was found 3.88 persons/family, is less member as compared to the other provinces, while the average size of the family in Takeo was 8.99 persons/family, is the biggest as compared to other provinces.

Table1. Family member

Description	Kompot n=60	Kompong Speu n=62	Prey Veng N=60	Takeo n=59	Overall n=241
Average	3.88	5.36	6.5	8.99	6.06
Max	5	6	7	13	13
Min	2	5	6	7	2
Std	0.87	0.48	0.5	1.28	1.92
<3	0	1 (1.67)	1 (1.67)	1 (1.7)	3 (1.24)
25					
3-5	(40.32)*	25 (41.67)	29 (48.33)	18 (30.51)	97 (40.25)
6-8	29 (46.77)	29 (48.33)	28 (46.67)	33 (55.93)	119 (49.38)
9-11	5 (8.06)	5 (8.33)	2 (3.33)	7 (11.86)	19 (7.88)
>11	3 (4.84)	0	0	0	3 (1.24)

\* Numbers in parentheses are percentages of n.

Most of the families surveyed were headed by male members, make up 95.44% and there were only few families with female as head of the family in the survey group (4.56%) as shown in Table 2.

Table2. Sex of household head

Description	Kompot n=60	Kompong Speu n=62	Prey Veng N=60	Takeo n=59	Overall n=241
Female	1 (1.67)	4 (6.45)	3 (5)	3 (5.08)	11 (4.56)
Male	59 (98.33)	58 (93.55)	57 (95)	56 (94.92)	230 (95.44)

\* Numbers in parentheses are percentages of n.

#### 4.2. Occupation:

The majority of the respondents in the study areas had farming as their main occupation (90.46%) as shown in Table 3. There were 19 household head (7.88%) who are the Government Officer.

Table 3. Distribution of the household head's occupation

Description	Kompot n=60	Kompong Speu n=62	Prey Veng n=60	Takeo n=59	Overall n=241
Carpenter	0	1 (1.64)	0	1 (1.69)	2 (0.83)
Farming	56 (93.33)	54 (88.52)	55 (91.67)	53 (89.83)	218 (90.46)
Officer	4 (6.67)	7 (11.48)	5 (8.33)	3 (5.08)	19 (7.88)
Weaver	0	0	0	2 (3.39)	2 (0.83)

\* Numbers in parentheses are percentages of n.

#### 4.3. Educational attainment:

The educational attainment variable in this study was divided in 6 categories: no education, primary not completed, primary, lower secondary, secondary/diploma and beyond and secondary.

Major of the household head reached the primary school level (31.54%), 1.24% of them has been to beyond and secondary level and 7.88% of them has never attended school (Table 4). This finding shows that most of the respondents were literate but reached only the compulsory educational level. It is noted that the literacy of husband was higher than wife.

Table 4. Education attainment

Description	Kampong Speu N=62	Kompot N=60	Takeo N=59	Prey Veng N=60	Overall N=241
Beyond and	1(1.61)	0	2(3.39)	0	3 (1.24)

secondary					
Lower secondary	12(19.35)	15(25)	6(10.17)	8(13.33)	41 (17.01)
No education	8(12.90)	2(3.33)	4(6.78)	5(8.33)	19 (7.88)
Primary	16(25.81)	20(33.33)	17(28.81)	23(38.33)	76 (31.54)
Primary not completed	9(14.52)	12(20)	21(35.59)	13(21.67)	55 (22.82)
Secondary/Diploma	16(25.81)	11(18.33)	9(15.25)	11(18.34)	47 (19.50)

\* Numbers in parentheses are percentages of n.

#### 4.5. Household income:

When asked about source of income, the respondents informed that on-farm and non-farm incomes were very important, while number of households also included the income from fish sold. The income included only the produce sold from farming such as rice, livestock and cultured fish, and salary income.

After data was analyzed, it found that annual total income of the household families in ranged from 62.5 US\$ to more than 5500 US\$. The average income of the household in Kompot was 528 US\$, 548.64 US\$ in Kompong Speu, 686.53 US\$ in Prey Veng and 784.72 US\$ in Takeo province. The highest average household income was found in Takeo province (784US\$), while the lowest average household income was 528 US\$ in Kompot province. More than 35% of the household in Kompot, Kompong Speu and Takeo had annual income ranged between 301-500US\$ and following by 30% of the household had income from 501 to 1000US\$. The overall average income of the household in these four provinces was 635 US\$ (Table 5).

Table 5. Household income (in US\$)

Description	Kampot n=60	Kampong Speu n=62	Prey Veng n=60	Takeo n=59	Overall n=241
Average	528.21	548.64	686.53	784.72	635.68
Max	4185	2096.25	1902.25	5525	5525
Min	63	150	62.5	150	62.5
Std	540.42	342.91	438.56	849.66	578.26
<150	6 (10)	0	3 (5)	0	9(3.73)
150-300	9 (15)	13 (20.97)	7 (11.67)	9 (15.25)	38 (15.77)
301-500	24 (40)	22 (35.48)	18 (30)	21 (35.59)	85 (35.27)
501-1000	18 (30)	20 (32.26)	19 (31.67)	16 (27.12)	73 (30.29)
1000-2000	2 (3.33)	6 (9.68)	13 (21.67)	10 (16.95)	31 (12.86)
>2000	1 (1.67)	1 (1.61)	0	3 (5.08)	5 (2.07)

\* Numbers in parentheses are percentages of n.

#### 4.6. Source of protein intake:

In general fish is the main source of protein supply for the Cambodian people. Based on the result of the study, it found that an average of the percentage of protein intake from fish in dry season was about 67.42% in Kompot, 62.58% in Kompong Speu, 68.63% in Prey Veng and 67.80% in Takeo province. There was no significantly different among the four provinces regarding the average of percentage of protein intake from meat, it was slightly bigger than 30%. On overall average of the percentage of protein intake from fish in dry season was about 66.57%, while 33.43% from meat (Table 6).

An average percentage of protein intakes from fish during rainy season was 75.67% in Kompot, 72.34% in Kompong Speu, 79.88% in Prey Veng and 73.08% in Takeo province, while the average percentage of protein intakes from meat was less than 30% for all household surveyed in the four provinces.

On overall average of the percentage of protein intake from fish consumed by all household surveyed in the four provinces was 75.23% in the rainy season and protein intake from meat was 24.81% (Table6). It was noted that the percentage of protein intake from fish by all households was higher as compared in dry season. This probably more fish available in rainy season as compared to the dry season and on the other hand people in rural areas make more effort to work in rainy season, hence more food need to consume.

Table 7 shows that majority of the household surveyed, 85% in Kompot, 80.65% in Kompong Speu, 65% in Prey Veng and 69.49% of the households in Takeo province consumed fish as a source of protein from 50 to 80% in dry season. While in rainy season, it was also found that higher percentage of households surveyed consumed fish as a protein source from 50 to 80% too.

Table 6. The percentage of protein intake by household surveyed

Description	Kompot n=60		Kompong Speu n=62		Prey Veng n=60		Takeo n=59		Overall n=241	
	Fish	Meat	Fish	Meat	Fish	Meat	Fish	Meat	Fish	Meat
<b>Dry season</b>										
Average	67.42	32.58	62.58	37.42	68.63	31.37	67.80	32.20	66.57	33.43
Max	100	80	90	70	98	90	95	80	100	90
Min	20	0	30	10	10	2	20	5	10	0
Std	13.95	13.95	14.51	14.51	19.99	19.99	18.41	18.44	16.95	16.95
<b>Rainy season</b>										
Average	75.67	24.33	72.34	27.66	79.88	20.12	73.08	27.08	75.23	24.81
Max	100	70	100	60	100	70	97	90	100	90
Min	30	0	40	0	30	0	10	3	10	0
Std	15.2	15.2	14.19	14.19	16.13	16.13	18.54	18.62	16.24	16.27

Table 7. Distribution of the percentage of protein intake by household surveyed

Protein intake (%)	Kompot n=60		Kompong Speu n=62		Prey Veng n=60		Takeo n=59		Overall n=241	
	Fish	Meat	Fish	Meat	Fish	Meat	Fish	Meat	Fish	Meat
<b>Dry season</b>										
<50	4 (6.67)	51 (85.00)	9 (14.52) 50	42 (67.74) 20	8 (13.33)	45 (75.00)	7 (11.86)	42 (71.19)	28 (11.62)	180 (74.69)
50-80	51 (85.00)	9 (15.00)	(80.65) 20	(32.26)	39 (65.00)	14 (23.33)	41 (69.49)	17 (28.81)	181 (75.10)	60 (24.90)
>80	5 (8.33)	0	3 (4.84)	0	13 (21.67)	1 (1.67)	11 (18.64)	0	32 (13.28)	1 (0.41)
<b>Rainy season</b>										
<50	2 (3.33)	53 (88.33)	2 (3.23) 48	54 (87.10) 8	3 (5.00)	54 (90.0)	4 (6.78)	52 (88.14)	11 (4.56)	213 (88.38)
50-80	43 (71.67)	7 (11.67)	(77.42) 12	(12.90)	30 (50.00)	6 (10.00)	39 (66.10)	5 (8.47)	160 (66.39)	26 (10.79)
>80	15 (25.00)	0	(19.35)	0	27 (45.00)	0	16 (27.12)	2 (3.39)	70 (29.05)	2 (0.83)

\* Numbers in parentheses are percentages of n.

#### 4.7. Catches and utilization of wild fisheries

##### • Catches of wild fisheries

In the past centuries, rural people are enjoyed in catching fish from nature, particularly for those people living around the *Great Lake* and rivers that have larger availability of fish, while in the Southeastern region of the country, the availability of fish is less as there is negligible production from the capture fisheries i.e. in the province like Kompot, Takeo, Kompong Speu, Prey Veng and Svay Rieng province,



which is considered to be poor in fisheries resources. Based on results of the survey in the selected provinces, majority of the household surveyed (97.5%) reported that the wild fisheries production has declined, while 2.49% of them said that it was increased. The main causes of declining wild fisheries, most of the people gave the answer that environmental changed: lost fish habitats, drought, and some human activities such as using illegal fishing gears, electro-fishing, pesticide use in the rice field, etc.

Table 8 shows the wild fish catches in rice field by households surveyed in the four provinces. The amount of fish catches ranged from 0.1kg-10kg per day, with an average caught of 0.93kg/day in Kompot, 0.66kg/day in Kompong Speu, 1.25kg/day in Prey Veng, 1.13kg/day in Takeo province. Majority of the household (55.36%) in Kompot, 68.52% in Kompong Speu, 43.14% in Prey Veng and 51.16% in Takeo got amount of fish from 0.2kg to 0.5kg/day. It was noted that about 23.26% of the households in Takeo got more than 1kg of fish catches, a slightly bigger than 17% of the households in Kompot and Prey Veng province got more than 1kg of fish catches, while the lowest percentage of households got more than 1kg of fish catches per day was 3.7% in Kompong Speu. On overall average amount of fish catches per day was 0.97kg. Most of the households involved in capturing fisheries were carried on in wet season from September to December and common species catches are snake head fish, clarias catfish, climbing perch and small spiny ell.

**Table 8 .Wild fish catches (kg/day) per household**

Description	Kompot n= 56	Kompong Speu n= 54	Prey Veng n= 51	Takeo n= 43	Overall n= 204
Average	0.93	0.66	1.25	1.13	0.97
Max	5	3	10	10	10
Min	0.2	0.2	0.2	0.1	0.1
Std	0.83	0.45	1.61	1.57	1.20
0.2-0.5	31 (55.36)	37 (68.52)	22 (43.14)	22 (51.16)	112 (54.90)
0.51-1	15 (26.79)	15 (27.78)	20 (39.22)	11 (25.58)	61 (29.90)
>1	10 (17.86)	2 (3.70)	9 (17.65)	10 (23.26)	31 (15.20)

\* Numbers in parentheses are percentages of n.

The study was also concerned on the annual fisheries catches by households surveyed. Concerning the annual catches per household, the question was asked directly to 55 household families that has got trap ponds. The results have shown that an overall average of fish caught from trap pond was 25.95kg/household in 2001, 19.44kg/household in 2002 and 15.86kg/household in 2003, with an overall approximately 38.88% of fish caught reduction in trap ponds from 2001 to 2003. If we breakdown by individual provinces, the results shows that the average wild fish caught from trap pond was decreased from 29.92kg in 2001to 14.13kg/household in 2003 in Kompot (about 52.77% decreased), decreased from 19.44kg to 7.50kg/household in Kompong Speu (about 61.41% decreased), decreased from 29.10kg to 20.67kg/household in Prey Veng (about 28.96% decreased) and decreased from 21kg to 13.25kg/household in Takeo (about 36.90% decreased) (Table 9).

**Table 9. Annual fish catches (kg) from trap pond per household**

Description	Kampot n=13	Kampong Speu n=9	Prey Veng n=21	Takeo n=12	Overall n=55
<b>Year 2001</b>					
Average	29.92	19.44	29.10	21	25.95
Max	70	50	70	40	70
Min	10	5	5	7	5
Std	17.36	15.70	21.30	10.58	17.36
<b>Year 2002</b>					
Description	Kampot	Kampong Speu	Prey Veng	Takeo	Overall

	n=13	n=9	n=22	n=10	n=54
Average	19.15	12.78	23.55	18	19.44
Max	30	30	50	35	50
Min	4	3	5	5	3
Std	8.27	9.38	15.53	8.56	12.32
<b>Year 2003</b>					
Description	Kompot n=15	Kampong Speu n=8	Prey Veng n=24	Takeo n=12	Overall n=58
Average	14.13	7.50	20.67	13.25	15.86
Max	40	10	50	40	50
Min	3	3	5	1	1
Std	9.58	3.46	12.84	10.33	11.47

- **Utilization of wild fisheries**

Households involved in capturing fisheries used their fish catches for different purposes depending upon the condition of fish obtained each time. Fish for consumption was a priority, than for sale (if catches consisted of good quality fish such as snake heads and walking catfish) and processing (if catches prevailed of small species). However, poor farmers prioritized good quality fish for sale rather than for consumption in order to get income for other purposes, while the non-marketable fish were allocated for consumption and/or processing if abundant.

When asked on fish consumption, fish consumed by households surveyed ranged from 0.1kg to 2.5kg with an average 0.55kg of fish per day in the dry season. In rainy season the amount of fish consumed by household families was 0.78kg per day, it was more than fish consumed in dry season. In both seasons, majority of the households consumed fish in the range 0.3-0.5kg/day. It was found that in dry season, the percentage of households consumed fish in the range 0.3 to 0.5kg/day was bigger than the households consumed fish in the same range in the rainy season (Table 10). While the percentage of households consumed fish in the rainy season in the range 0.8-1kg/day found bigger than households consumed fish in the same range in the dry season.

Table 10. Fish consumption (kg/day) per household

Description	Dry season	n =238	Wet season	n =239
Average	0.55		0.78	
Max	2.5		2.5	
Min	0.1		0.1	
Std	0.31		0.44	
<0.3	29	(12.18)	10	(4.18)
0.3-0.5	152	(63.87)	109	(45.61)
0.51-0.8	9	(3.78)	18	(7.53)
0.81-1	45	(18.91)	79	(33.05)
>1	3	(1.26)	23	(9.62)

\* Numbers in parentheses are percentages of n.

Besides catching fish from natural water bodies for home consumption, every household also spent some money to buy fish from markets. Based on results of the survey, 53.33% of the households surveyed in Kompot reported that purchased fish regularly in dry season, 82.26% of households in Kampong Speu, 55% in Prey Veng and 72.88% in Takeo province. In rainy season, most of the household purchased fish more occasionally, it found that 55% of households in Kompot purchased fish occasionally, 70.97% in Kampong Speu, 56.67% in Prey Veng and 57.63% of households in Takeo province. On overall, the percentage of households purchased fish at more regularly in dry season (65.98%) was higher as compared

to the rainy season (18.25%), while in the rainy season the percentage of households purchased fish at more occasionally (60.17%) was higher than in dry season (29.04%). It was noted that few households in Kompot and Prey Veng province did not purchase fish for consumption in the dry season. In the rainy season, few households in Kompong Speu and Takeo reported that "never purchased fish", while more than 30% of the household in Kompot and Prey Veng province did not buy fish in the rainy season (Table 11).

Table 11. Fish purchasing for consumption

Description	Kompot n=60	Kampong Speu n=62	Prey Veng n=60	Takeo n=59	Overall n=241
<b>Dry season</b>					
Never	7 (11.67)	0	5 (8.33)	0	12 (4.98)
Occasionally	21 (35)	11 (17.74)	22 (36.67)	16 (27.12)	70 (29.04)
Regularly	32 (53.33)	51 (82.26)	33 (55)	43 (72.88)	159 (65.98)
<b>Rainy season</b>					
Never	21 (35)	4 (6.45)	20 (33.33)	7 (11.86)	52 (21.58)
Occasionally	33 (55)	44 (70.97)	34 (56.67)	34 (57.63)	145 (60.17)
Regularly	6 (10)	14 (22.58)	6 (10)	18 (30.51)	44 (18.25)

\* Numbers in parentheses are percentages of n.

Table 12 shows the data relating to money spending to purchase fish for consumption by household respondents. There was a significant difference between the mean money spent for buying fish in dry season by households surveyed in Kompot, Kompong Speu and Prey Veng province. It was found that on average about 11.51US\$/month spent by a household in Kompot to buy fish in the dry season, 11.78US\$ by a household in Kompong Speu, 11.63US\$ in Prey Veng and slightly spent more 16.84US\$/month by a household in Takeo province. On overall, in the rainy season, they spent less money to buy fish as compared to the dry season. If breakdown by individual provinces, it was found that the average money spent is 7.44US\$/month in Kompot, 8.01US\$/month in Kompong Speu, 7.72US\$/month in Prey Veng and 12.25US\$/month in Takeo province.

Table 12. Money spending to purchase fish for consumption per month (in US\$)

Description	Kompot n=57	Kampong Speu n=62	Prey Veng n=55	Takeo n=59	Overall n=233
<b>Dry season</b>					
Average	11.51	11.78	11.63	16.84	12.92
Max	37.5	37.5	37.5	50	50
Min	0.88	1.25	0.75	0.75	0.75
Std	7.32	9.16	7.47	11.85	8.79
<b>Rainy season</b>					
Description	Kompot n=39	Kampong Speu n=57	Prey Veng n=41	Takeo n=53	Overall n=190
Average	7.44	8.01	7.72	12.25	9.01
Max	30	50	50	45	50
Min	1.75	0.63	0.7	0.38	0.38
Std	6.12	7.23	8.45	10.71	8.59

#### 4.8. Pond characteristics:

Ponds varied in size from 32-1600m<sup>2</sup>. On average ponds in Kompot were the smallest (209.27m<sup>2</sup>), while ponds in Takeo were the largest (295.34m<sup>2</sup>). The majority of ponds fall in the range of 101-200m<sup>2</sup>

were found about 65% in Kompot, 37.10m<sup>2</sup> in Kompong Speu, 40% in Prey Veng province. The ponds are bigger than 200m<sup>2</sup> were found in Takeo province with the highest percentage (44.07%) and the most heterogeneous in size as shown in Table 13.

Table 13. Pond size (m<sup>2</sup>)

Description	Kompot N=60	Kompong Speu N=62	Prey Veng n=60	Takeo n=59	Overall n=241
Average	209.27	251.06	216.43	295.34	242.88
Max	875.00	1600.00	800.00	1500.00	1600.00
Min	42.00	36.00	40.00	32.00	32.00
Std	167.06	328.66	176.09	282.11	249.64
<80	2 (3.33)	10 (16.13)	6 (10.00)	3 (5.08)	21(8.71)
80-100	5 (8.33)	13 (20.97)	13 (21.67)	14 (23.73)	45 (18.67)
101-200	39 (65.00)	23 (37.10)	24 (40.00)	16 (27.12)	102 (42.32)
>200	14 (23.33)	16 (25.81)	17 (28.33)	26 (44.07)	73 (30.29)

\* Numbers in parentheses are percentages of n.

The ranges of the water depth in ponds were 1.5 to 3 meters with an average depth in pond was about 2 meters. On average, there was water in the ponds for about 8 months. Water was more abundant in Prey Veng, Kompot and Takeo province, which are situated on low land area, while water less was in Kompong Speu province, which is a little bit located on upland area. In some cases, the ponds were dry for five months in a year. Although some water is retained in ponds over a long period as indicated above, the depth is often not enough to culture fish. For example, fish pond in Kompong Speu, water retention was for about 8 months, but in most cases, fish had to be harvested after about 5 months due to insufficient depth of water.

#### 4.9. Purpose of pond construction and uses

Several purposes of pond digging were found during the study such as for fish culture, house building, use of pond water, fish culture/water use. Most of the farmers reported that their pond was dug for fish culture, (36.67%) in Kompot, 35.48% in Kompong Speu, 61.67% in Prey Veng and 35.59 in Takeo province.

The main use of the pond water was for washing, watering and animal drinking as reported by 21.99% of the households in the four provinces. If breakdown by individual province, the purpose of using pond water was found 21.67% in Kompot, 27.42% in Kompong Speu, 11.67% in Prey Veng and 27.12% in Takeo province. A small percentage of households (less than 12.90% of households) in these four provinces dug the ponds for taking soil for house building (Table 14).

Table 14. The purpose of pond construction and uses

Description	Kompot N=60	Kompong Speu N=62	Prey Veng N=60	Takeo N=59	Overall N=241
Fish culture	22 (36.67)	22 (35.48)	37 (61.67)	21 (35.59)	102 (42.32)
Fish culture/plant vegetable	2 (3.33)	2 (3.23)	0	1 (1.69)	5 (2.07)
Water use/fish culture	21 (35)	13 (20.97)	12 (20)	15 (25.42)	61 (25.31)
House building	2 (3.33)	8 (12.90)	4 (6.67)	6 (10.17)	20 (8.30)
Water use	13 (21.67)	17 (27.42)	7 (11.67)	16 (27.12)	53 (21.99)

\* Numbers in parentheses are percentages of n.

Most of the ponds (82.99%) were dug by family member force or by hiring labors, while 15.35% of the ponds were constructed under various programs in the past such as WFP, APHEDA and GTZ with supporting food for work. The lowest percentage 65% of the ponds in Kompot were dug by owned family. The percentage of ponds were dug by owned family were not significantly difference among the other three provinces, which was 93.55% in Kompong Speu, 85% in Prey Veng and 88.14% in Takeo province (see Table 15).

The lowest percentage of ponds (4.84%) were dug with supporting by NGOs was found in Kompong Speu province, while the highest percentage (35%) of the ponds were dug with supporting by NGOs was found in Kompot province.

Table 15. Pond construction

Description	Kompot N=60	Kompong Speu N=62	Prey Veng N=60	Takeo N=59	Overall N=241
NGO	21 (35)	3 (4.84)	9 (15)	4 (6.78)	37 (15.35)
Own	39 (65)	58 (93.55)	51 (85)	52 (88.14)	200 (82.99)
Other	0	1 (1.61)	0	3 (5.08)	4 (1.66)

\* Numbers in parentheses are percentages of n.

#### 4.10. Fish ponds culture:

Totally 241 households surveyed, there were only 139 households (57%) started growing fish few years ago. Most of the fish farmers initiated family fish culture activities in 2001 with a small percentage of them received technical supports from a few International/Non M Governmental Organizations such as APHEDA, READ/MRC, FAO and PADEK.

Poly culture of five fish species consisted of Puntius gonionotus, Tilapia, Silver carp, Common carp and Pangasius catfish were introduced into the ponds, while mono culture of Pangasius catfish were stocked in few ponds in the study areas. Fish seed were stocked when there was good water available in ponds, especially during July and September. All most of the fish farmers got fish seed to stock into their ponds from local small scale private hatcheries, while they got fish seed from the Government hatcheries when there was not seed available at the private hatcheries.

After stocking of fish seed, rice bran was the common input used by all fish farmers. In addition to rice bran, Lemna (duck weed) was commonly used, particularly during rainy season when it is available in abundant. Other types of feed material used included termites, broken rice, kitchen waste, vegetable waste, etc.

#### 4.11. Harvest of fish and utilization of the harvested fish:

Fish culture production details were collected from only 111 households and the other households still left with many fish in the pond and harvesting have not been completed during survey was conducted. Most of the families started catching big size of fish from their pond for family consumption after fish were stocked in pond for about 3 months. The bulk harvesting was done between January and March when the depth of pond water getting shallow. For the partial harvesting they used gill net or castnet to catch fish, but for a bulk harvesting they usually dry out of the pond. The average actual production, production of fish (kg/100m<sup>2</sup>) in one pond and each year were shown in Table 16.

Majority of the fish farmers reported that approximately 70% of the cultured fish production was used for family consumption, while 30% of the cultured fish production was used for selling to get cash for buying fingerling to stock in the next season or to buy some materials to meet the needs of the family.

Table 16. Fish pond production (kg) by years

2001	Kompot n=14			Kompong Speu n=11			Prey Veng n=26			Takeo n=14		
	Pond size (m <sup>2</sup> )	Actual Pdn (kg)	Pnd (kg)/100m <sup>2</sup>	Pod size	Actual pdn	Pdn (kg)/100m <sup>2</sup>	Pod size (m <sup>2</sup> )	Actual pdn (kg)	Pdn (kg)/100m <sup>2</sup>	Pond size (m <sup>2</sup> )	Actual Pdn (kg)	Pnd (kg)/100m <sup>2</sup>
AVG	315.36	41.43	15.97	433.82	50.45	20.52	376.00	283.52	61.56	352.50	133.29	45.69
MAX	875.00	150.00	40.00	1320.00	200.00	41.67	980.00	3000.00	375.00	784.00	400.00	166.67
<sup>a</sup> MIN	100.00	10.00	3.33	80.00	5.00	3.79	75.00	3.00	0.57	96.00	12.00	5.71
STD	250.59	37.44	11.04	524.10	51.89	13.82	264.57	609.96	87.26	235.17	123.11	44.27

2002	Kompot n=22			Kompong Speu n=13			Prey Veng n=28			Takeo n=20		
	Pond size	Actual Pdn	Pnd (kg)	Pond size	Actual Pdn (kg)	Pnd (kg)	Pond size	Actual Pdn (kg)	Pnd (kg)	Pond size	Actual Pdn	Pnd (kg)

	(m <sup>2</sup> )	(kg)	/100m <sup>2</sup>	(m <sup>2</sup> )		/100m <sup>2</sup>	(m <sup>2</sup> )		/100m <sup>2</sup>	(m <sup>2</sup> )	(kg)	/100m <sup>2</sup>
<b>AVG</b>	237.86	44.77	20.52	334.92	54.69	26.20	339.00	228.86	68.37	327.80	107.10	47.53
<b>MAX</b>	875.00	230.00	50.00	1221.00	250.00	55.56	980.00	1300.00	240.00	1500.00	350.00	175.88
<b>MIN</b>	100.00	10.00	5.00	36.00	15.00	5.00	75.00	8.00	7.20	80.00	15.00	2.50
<b>STD</b>	192.30	45.53	11.28	428.42	63.24	15.16	266.80	318.59	59.34	333.79	115.76	49.79

2003	Kompot n=32			Kompong Speu n=19			Prey Veng n=33			Takeo n=27		
	Pond size (m <sup>2</sup> )	Actual Pdn (kg)	Pnd (kg) /100m <sup>2</sup>	Pond size (m <sup>2</sup> )	Actual Pdn (kg)	Pnd (kg) /100m <sup>2</sup>	Pond size (m <sup>2</sup> )	Actual Pdn (kg)	Pnd (kg) /100m <sup>2</sup>	Pond size (m <sup>2</sup> )	Actual Pdn (kg)	Pnd (kg) /100m <sup>2</sup>
<b>AVG</b>	210.78	39.28	19.62	276.37	43.63	28.53	331.85	175.97	51.11	266.59	120.96	50.31
<b>MAX</b>	875.00	290.00	50.93	1221.00	300.00	89.29	980.00	1350.00	160.71	700.00	500.00	222.22
<b>MIN</b>	80.00	3.00	1.79	36.00	10.00	1.64	75.00	7.00	3.85	80.00	5.00	1.67
<b>STD</b>	176.55	52.19	13.59	367.73	63.97	23.91	244.96	289.06	47.98	191.66	157.36	54.39

#### 4.12. Family member participation in fish culture:

Fish culture was undertaken by families' members in the existing ponds which were constructed. Although, overall men were responsible in majority of the cases, in several families women were responsible day to day management of the fish ponds. Generally, women (wife) were found to be contributed about 35% of fish culture work in the family, 50% of fish culture work was contributed by men (Husband) and the rest was contributed by children in the family. Men were active in prestocking operation such as pond digging, pond fertilization and finding seed to stock in the pond and final harvesting. After stocking of fish seed, it was women, who took care of most of the activities in terms of feeding, pond fertilization and selling fish. Children were also found to be active in fish culture such as involved in fish feed search, feeding to fish and harvesting fish.

#### 4.13. Constraints faced by fish farmers at present:

Some farmers had been able to harvest good production of fish from the cultured ponds because they were able to stock fish seed early in the season or stocked bigger size seeds. Large majority of farmers were faced with the poor survival of the cultured fish due to stocking was delayed (late in the season) or farmers were not able to stock with good size seed, most of the fish were predated by wild fish and farmers end with poor production of cultured fish.

Farmers encountered a number of problems with the operation of fish culture. The two most difficulties reported were the inadequate of basic fish culture technology (36.69%) and inadequate supply of good quality fish seed (20.14%). Shortage of water in pond during the dry season was considered as a problem reported by farmers (13.67%) and followed by the deficit of operation cost (10.19%), which was reflected by their lower levels of input use for fish culture operation and low fish production (Table 17).

Table 17. Major constrains faced by fish farmers at present

Description	N=139	%
Lack of fish culture technology	51	36.69
Quality of fish seeds	28	20.14
Shortage of water in dry season	19	13.67
Deficit of operation cost	15	10.79
Predation	10	7.19
Unavailability of seed	7	5.04
Water quality	5	3.60
Low market price	4	2.88

#### 4.14. Farmer' assessment and attitudes to fish culture;

Excepting few fish farmers whose ponds got low production of fish, rest of them expressed satisfaction with the production obtained. Most of the farmers (98.56%) who started fish culture expressed interest to continue culture fish during the next season.

For those farmers interested to continue fish culture as indicated above, 59.71% expressed a desire to more expand scale, 37.41% of farmers were in favor of continuing at the present scale, 1.44% at reduced scale, while 1.44% wanted to discontinue fish culture because of too short a period of water retention in pond and water was not enough to share with livestock (Table 18).

Table 18. Fish farmers' attitudes with regard to future involvement in fish culture

Description	N=139	%
At more expanded scale	83	59.71
At the present scale	52	37.41
At reduce scale	2	1.44
Discontinue	2	1.44

For those farmers whose have got pond but have not started fish culture yet, more than 90% of them will interest to use pond for fish culture, while a small percentages of them were also interested in doing fish culture but they could not do it because of lack of money to buy seed and lack of labor forces in the family.

Based on the results of the study, we found that majority of the farmers (60.25%) wanted to grow fish was mainly for family consumption, 30.54% for both consumption and selling, while the smallest percentage of them (2.93%) intended to sell out (Table 19). When asked on planning to become a seed producer, about 11% of them were wanted to be seed producer, while the rest of them did not want to be seed producer because limited of land space, no knowledge on seed production, lack of capital investment and lack of labor.

Table 19. The main purposes of growing fish

Description	N=239	Percentage
Consumption and selling	73	30.54
Mainly for family consumption	144	60.25
mainly for marketing	7	2.93
Only if excess desire to sell	17	6.28

#### 4.15. What are the needs for starting fish culture in the future?

Training on fish culture was the most need by trial fish farmers (72.66%) and 67.65% by non-trial fish farmers. While seed quality was an important need by non-trial fish farmers (21.57%). The details of the needs by farmers to start doing fish culture in the future as shown in table 20.

Table 20. The priority needs to start fish culture in the future

Description	Training	Seed quality	Finance	Market
*Trial fish farmer n = 139	101 (72.66)	5 (3.60)	20 (14.39)	1 (0.72)
**Non-trial fish farmer n =102	69 (67.65)	22 (21.57)	11 (10.78)	0
Overall n= 241	170 (70.54)	27 (11.20)	31 (12.86)	1 (0.41)

Numbers in parentheses are percentages of n.

\* Trial farmer: Farmers who has started growing fish already

\*\* Non-trial farmers: Farmers who have not started growing fish yet

## 5. Conclusion

The results of the survey indicated that fish is the main source of protein supply to the rural people of the surveyed areas. The production of wild fish caught in surveyed provinces was decreased about 38.88% from 2001 to 2003 and lead to the decrease of fish consumption in the families.

A small-scale fish pond culture system which was carried out by a number of farmers is recognized as an appropriate system to meet the fish requirement of rural farmers.

The main benefits of small-scale fish pond culture were identified as follows: increased fish availability thereby its contribution to food security; improved financial situation owing to some saving for buying fish from markets and additional income from the sale of fish; better use of on-farm unused resources; improved nutrition of the families due to the increased fish consumption and improved women participation in fish culture activity.

The basic of fish culture techniques was considered as major problem by majority of farmers. Hence, the improvements to fish culture techniques and increase information available were recognized as the most immediately need of the farmers to success in doing fish culture in the future. Therefore, it would be appropriate to design strategies to increase participation of farmers in training, to design extension mechanisms in order to deliver extension messages to their door step using booklets, leaflet, posters, audio/video, etc.

Presently, inadequate availability of good quality fingerling was also considered as main problem by farmers and the fish seeds for stocking in ponds have to be obtained from distant places. Other problems such as lack of capital, credit availability and the interest rate remain as major issues constraints farmers to operate fish culture. To solve these problems, the creation of small-scale private hatcheries and the provision of credit/low interest rate would help farmers to increase fish culture activity.



## 別添資料 4

プロジェクトコンセプト

# カンボジア淡水養殖改善・普及計画

農村開発部

## プロジェクトの背景(基本情報)

国土面積: 18.1万Km<sup>2</sup> 人口: 1140万人

1人当たりGNI: 310米ドル(2003年, 世銀)

人間開発指数(2002年): 0.568(175カ国中130位)

主要産業: 農業(GDPの36%)



## JICAの対カンボジア援助重点分野

グッド・ガバナンス  
経済成長のための環境整備  
経済・社会インフラの整備  
保健医療の充実  
教育の充実  
**農業・農村開発**  
地雷撤去・障害者支援  
環境資源管理

## カンボジアにおける農業・農村開発の現状

農業は、GDPの約4割を占める基幹産業  
内戦により、灌漑水路などが破壊され、近代化が著しく遅延  
国民の8割は、農村部に居住  
農村居住者の約4割は、貧困ライン(1日0.41米ドル)以下の生活を営む  
周辺アセアン諸国と比較し、米の生産性が低い

(カンボジア周辺アセアン諸国の水稲の単位収量 (トン/ha))

カンボジア	ラオス	ベトナム	タイ	(日本)	アジア平均
1.9	3.4	4.5	2.5	6.5	3.9

2002年 FAO統計

## カンボジアにおける水産業の現状

周辺アセアン諸国と比較して、漁獲量・養殖量が少ない  
養殖量は最低(内戦による国土の荒廃、人材の不足、  
乾季の早魃と雨季の洪水が主な要因)

殆んどの漁獲量は、トンレサップ湖及びメコン川  
湖や河川から離れている農村部では、水産物の供給量が不足

カンボジア周辺アセアン諸国の水産物生産量 (万トン)

	カンボジア	ラオス	ベトナム	タイ	ミャンマー
漁獲量	40.6	3.3	150.8	292.1	131.2
養殖量	1.4	6.0	51.8	64.5	12.1
養殖の割合 (対全生産量)	3.3%	64.5%	25.5%	18.0%	8.4%

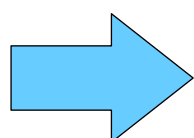
2002年 FAO統計

## カンボジアにおける養殖の現状

養殖生産量の全漁業生産量に占める割合: 3.3%

不十分な普及活動

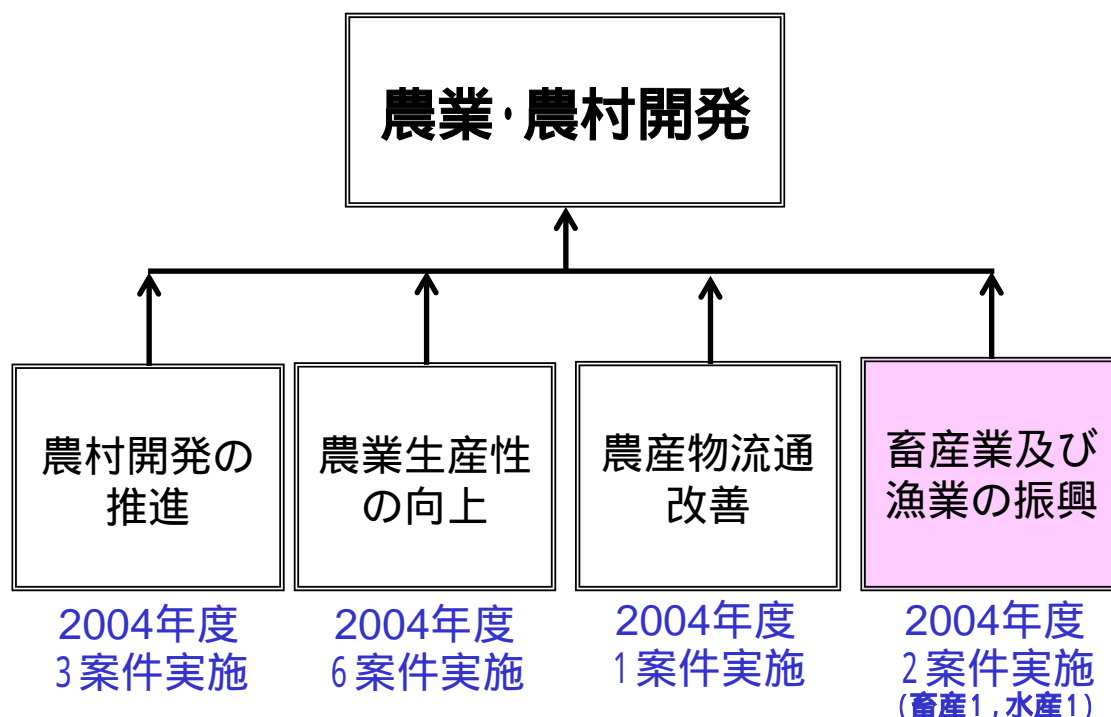
農村部への種苗供給量の不足



カンボジア第2次社会経済開発  
5ヵ年計画(2001-2005年)では、  
**農村地域における小規模養殖の振興と**  
生産量の300%の増加が  
目標のひとつにあげられている

## JICAの対カンボジア援助重点分野

### 「農業・農村開発」(プログラムツリー)



## JICAの対カンボジア援助重点分野

### 「農業・農村開発」(2004年度案件実施状況)(1)

開発課題名	プログラム名	案件名	2002	2003	2004	2005	2006
農村開発の推進	農村開発計画 (優先順位1)	三角協力プロジェクトマネージャー(長期専門家)	■	■	■		
		ブンベン市周辺村落給水計画(無償)		■	■	■	
		南部・中部村落給水計画(無償)			■	■	
農業生産性の向上	農業生産基盤整備計画 (優先順位2)	農地水資源アドバイザー(長期専門家)	■	■	■		
		灌漑技術センター計画(技プロ)	■	■	■	■	
		カンダルストーン灌漑施設改修計画(無償)			■	■	
		プレクトノット川流域農業総合開発計画調査(開調)			■	■	
	農業技術向上・普及計画 (優先順位3)	バットンバン農業生産性強化計画(技プロ)		■	■	■	
		農業アドバイザー(長期専門家)			■	■	

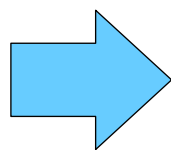
\* 上表は、2004年度実施の技プロ・開調・無償・長期専門家派遣案件のみ抽出  
 緑色は、技プロ・開調・無償案件を示す

# JICAの対カンボジア援助重点分野

## 「農業・農村開発」(2004年度案件実施状況)(2)

開発課題名	プログラム名	案件名	2002	2003	2004	2005	2006
農産物流通改善	農産物流通・収穫後処理改善計画 (優先順位4)	公開初市場整備計画調査(開調)			■		
畜産業及び漁業の振興	畜産・漁業振興計画 (優先順位5)	(畜産) タイ及び周辺国における家畜疾病防除計画(広域技プロ)	■	■	■	■	■
		(水産) 漁業制度(長期専門家派遣)			■		

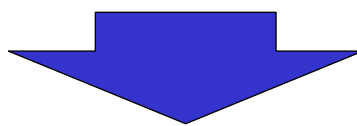
\* 上表は、2004年度実施の技プロ・開調・無償・長期専門家派遣案件のみ抽出  
 緑色は、技プロ・開調・無償案件を示す



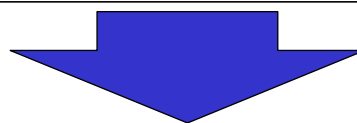
現在カンボジアから、水産養殖の支援を強く要請されている

## 農村における生計向上のためのアプローチ

- ・ 乾季の旱魃と雨季の水害のため、稲作の生産性が低い  
 灌漑面積は、稲作付面積の約23%
- ・ 乾季に水が確保しにくい 米の二期作が困難



農村における生計の向上のためには  
 米の生産性の向上に加え、**農家生計の多角化**を図る必要がある



< 具体的方策 >

**淡水養殖等を組み合わせた総合的な営農**

## カンボジアに適合する低投入の淡水養殖

内陸の農村部でも、既存の水田・水路・ため池等  
を活用して実施可能

新鮮な食料が、身近に備蓄できる

生活残渣などの活用により、簡便に実施可能

養豚・養鶏と組み合わせると、効果的

農業(稲作)等と並行して実施可能

短期間(約6ヵ月間)で、魚の育成が可能

発展段階に応じて、現金収入源ともなる

農家の生計の多角化に寄与

## カンボジアにおける食生活の状況

カンボジアにおける1日当たりカロリー供給量(Kcal/人/日)

カンボジア	ラオス	ベトナム	タイ	ミャンマー	(アジア)
2045.8	2311.7	2566.2	2467.3	2937.1	2695.7

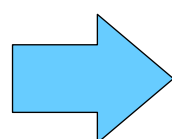
2002年 FAO統計

カンボジアの総人口に占める栄養不足人口の割合

カンボジア	ラオス	ベトナム	タイ	ミャンマー	(アジア)
38%	22%	19%	19%	7%	16%

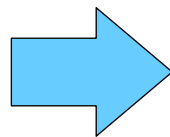
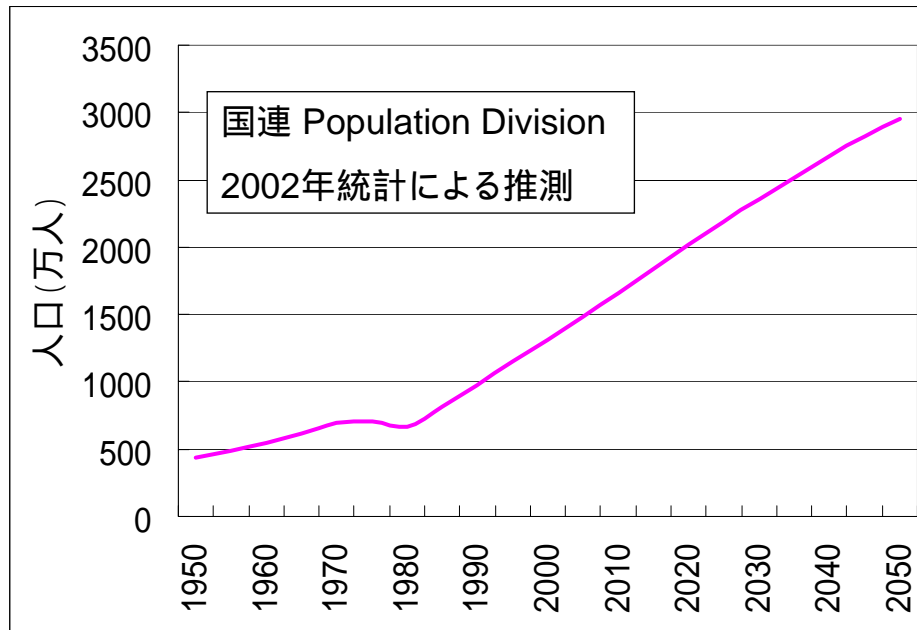
2001年 FAO統計

カロリー供給量は、カンボジア政府が定める1日当たり  
必要摂取量(2100 Kcal)よりも低く、周辺アセアン諸国と比べ、  
栄養状況は最低



供給カロリーの増加と  
栄養不足人口の削減が必要

# カンボジアにおける人口の推移見通し



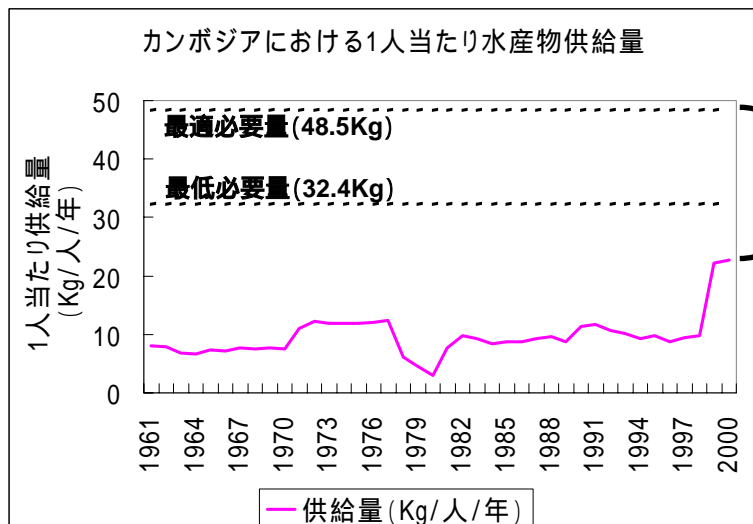
**栄養改善の対策が急務**

## カンボジアにおける栄養改善のためのアプローチ

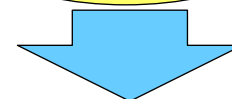
カンボジアにおける水産物の必要摂取量

現在供給量*1	最低必要摂取量*2 (必要タンパク質摂取の1/3=動物タンパク 動物タンパク質の3/4 = 水産物)	最適必要摂取量*2 (必要タンパク質摂取の1/2=動物タンパク 動物タンパク質の3/4 = 水産物)
22.9 Kg/人/年	32.4 Kg/人/年	48.5 Kg/人/年

出典: \*1 FAO統計 2001年 \*2 世銀APIP Technical Paper No.4 (2001)



需給ギャップの存在



**安価なタンパク食料  
である、淡水魚の  
供給増大が必要**



## 人間の安全保障の視点

農民の能力強化(エンパワメント)を重視

農家経営の多角化の一環として養殖技術を普及し、農家生計の向上を図るとともに、農民主体での養殖普及体制の確立を目指す。

農民の栄養改善を重視

養殖技術の普及により、農村部に重要な動物タンパク食料である淡水魚を供給し、需給ギャップを緩和し、農民の栄養改善を目指す。

最貧農民にも裨益する活動を重視

共有池を活用した資源増殖活動を実施し、土地を持たない最貧農民<sup>(注)</sup>も、淡水魚を自給できる仕組み作りを目指す。

(注)土地なし最貧農民：小作農民及び季節雇いの農業労働者

## 本プロジェクトの目的・内容

< 目的 >

プロジェクト対象地域において、小規模の種苗生産技術及び養殖技術が広く普及する。

協力期間：2005年1月～2010年1月(5年間)

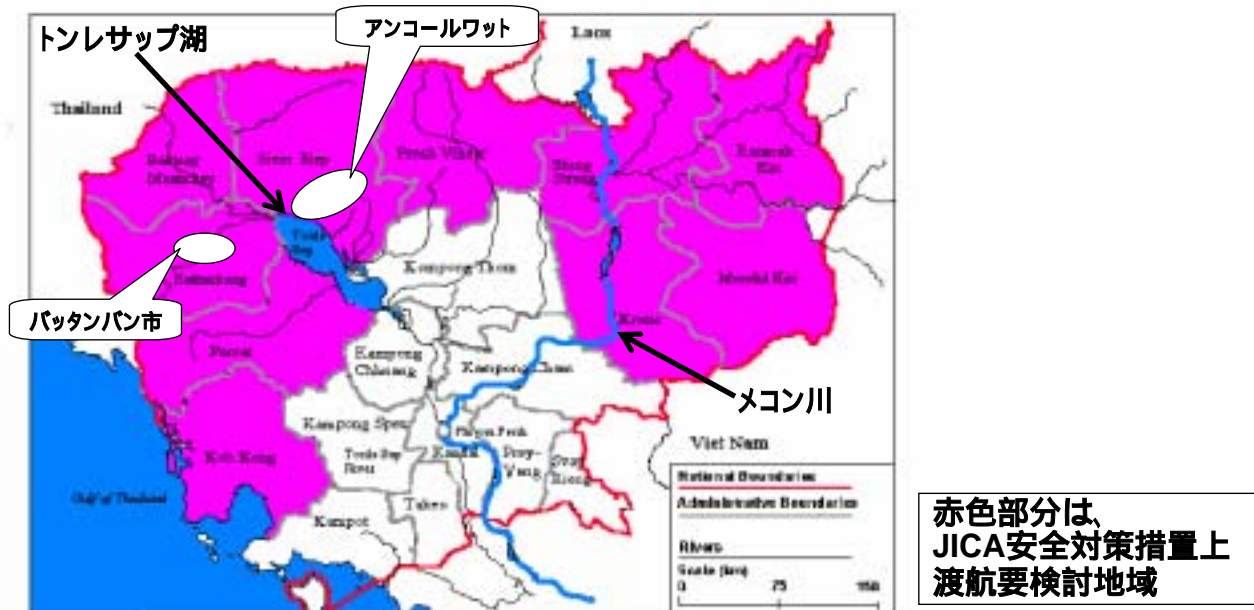
協力総額：約5.5億円

< 内訳 >

- ・ 専門家派遣経費 約3.5億円  
(滞在型：3名，短期：約3名/年)
- ・ 施設・機材関係費 約0.5億円
- ・ プロジェクト活動費 約1.0億円
- ・ 研修員受入れ経費 約0.5億円

## 本プロジェクトの対象地域の検討(1)

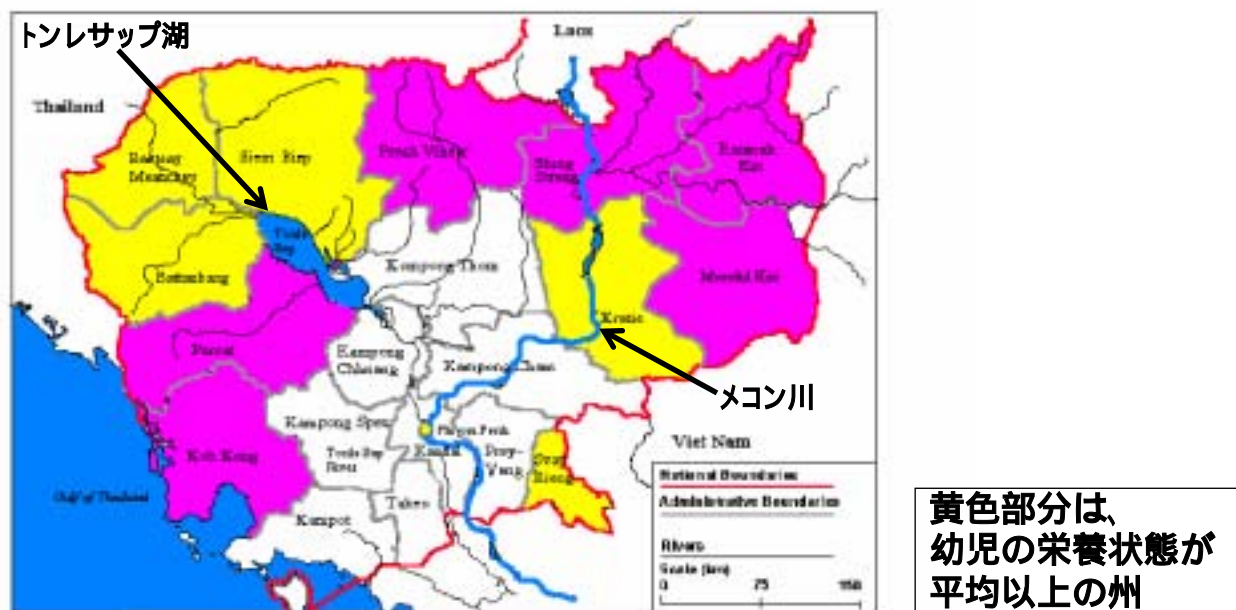
治安状況から検討



出典: JICA安全管理情報

## 本プロジェクトの対象地域の検討(2)

栄養状態から検討



出典: 州別幼児(6~59月齢)平均体重

(FAO "Nutrition Country Profile – CAMBODIA" 1999年)



## 本プロジェクト活動の概要

### 種苗生産農家 (地域普及の中核)

専門家と地域普及員が、既存養殖農家に対して養殖技術の指導を行い、種苗生産農家を抽出・育成する。

### 新規養殖農家 (生計の多角化)

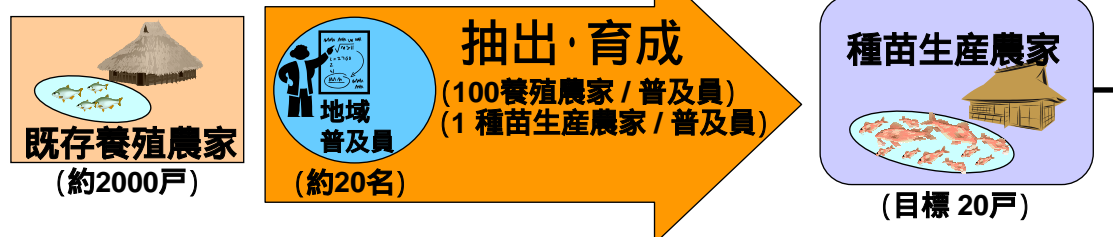
新たに育成される種苗生産農家から種苗の供給を受けて、その養殖に取り組む新規養殖農家を支援する。

### 土地なし最貧農民 (栄養の改善)

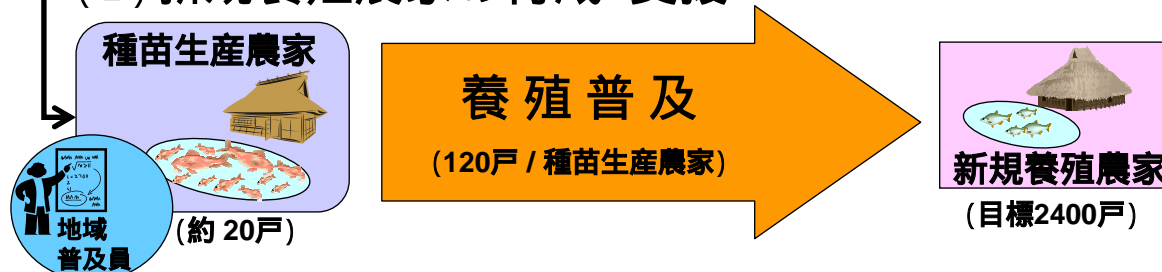
土地を持たない最貧農民に、食料としての魚類を安定的に供給するため、共有池を活用した資源の増殖管理を支援する。

## 小規模養殖の普及体制の形成

### (1) 種苗生産農家の育成



### (2) 新規養殖農家の育成・支援





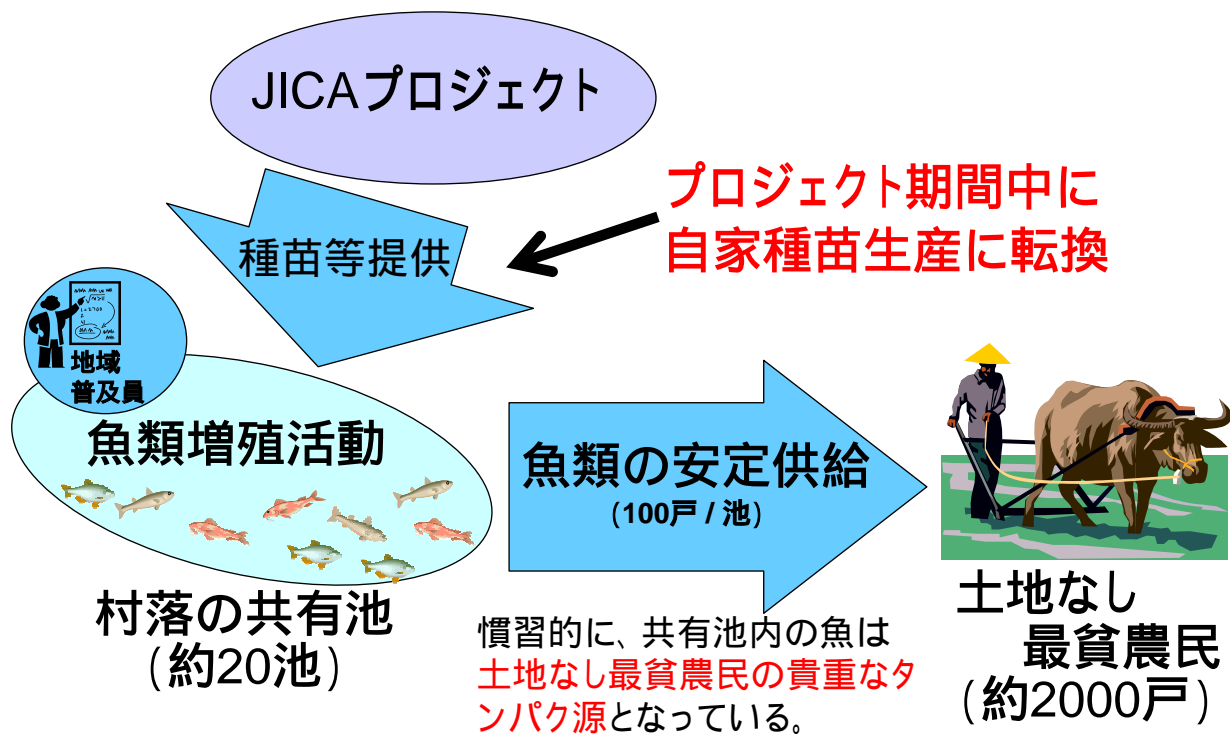
## 地域の種苗生産農家の例



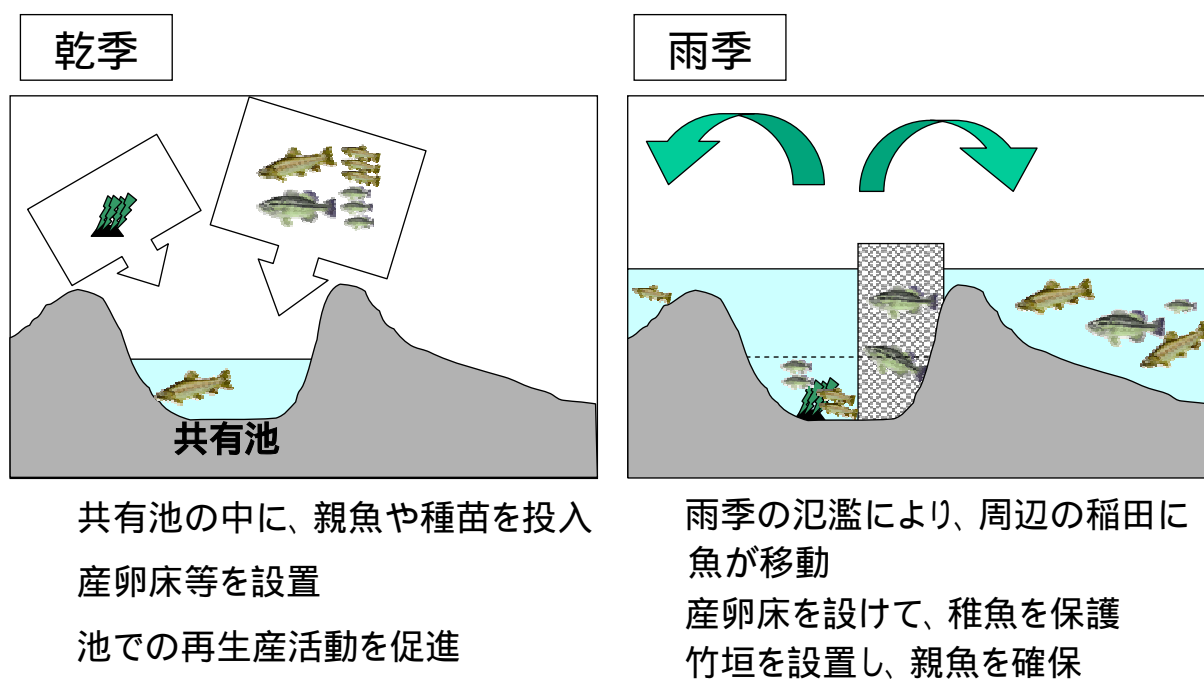
## 小規模養殖農家の養殖池の例



## 土地なし最貧農民に対する魚類の安定供給



## 共有池の管理手法



## 共有池



## 本プロジェクトの養殖対象魚種





## プロジェクトの成果

### < 即効的効果 >

淡水養殖は、低投入で簡便であるため、農業と並行して実施でき、農村部における淡水魚の需給ギャップの緩和と栄養の改善に寄与する。

### < 長期的効果 >

高い自立発展性

商業インセンティブが働く種苗生産農家を主体とする

農民間の養殖普及ネットワークの形成

食料安全保障の促進

栄養不足人口の減少と摂取カロリーの増加

人間の安全保障の促進

土地を持たない最貧農民にも裨益効果

## プロジェクト実施後の農村イメージ



カンボジア水産局作成